NORTHROP GRUMMAN
Space Technology

TPF EXPO
Current Development Status of the ACTDP Program at NGST
10/16/03

Emanuel Tward

Authors: Jeff Raab, Mike Petach, Rocco Orsini, Mike Waterman, Tanh Nguyen, Ralph Colbert, Mark Michaelian, and Emanuel Tward

NORTHROP GRUMMAN
Space Technology

Program Scope

- The contractor shall
  - design, fabricate, assemble test and deliver
    - an ACTDP cryocooler thermal mechanical unit engineering model (EM)
    - brass board electronics (BE),
    - and associated test equipment and documentation.

NORTHROP GRUMMAN
Space Technology

Program Objectives

- The objective of this program is to
  - Develop an efficient 2 stage EM mechanical cooler providing cooling at 6K and 18K
  - The mechanical cooler shall be form, fit and function identical to a flight cooler
  - The cooler shall be designed to the requirements of the ACDTP Cryocooler Specification (TPF, ConX, JWST)
  - The cooler shall be designed with modular components
  - The cooler shall incorporate simple mechanical, thermal and electrical interfaces

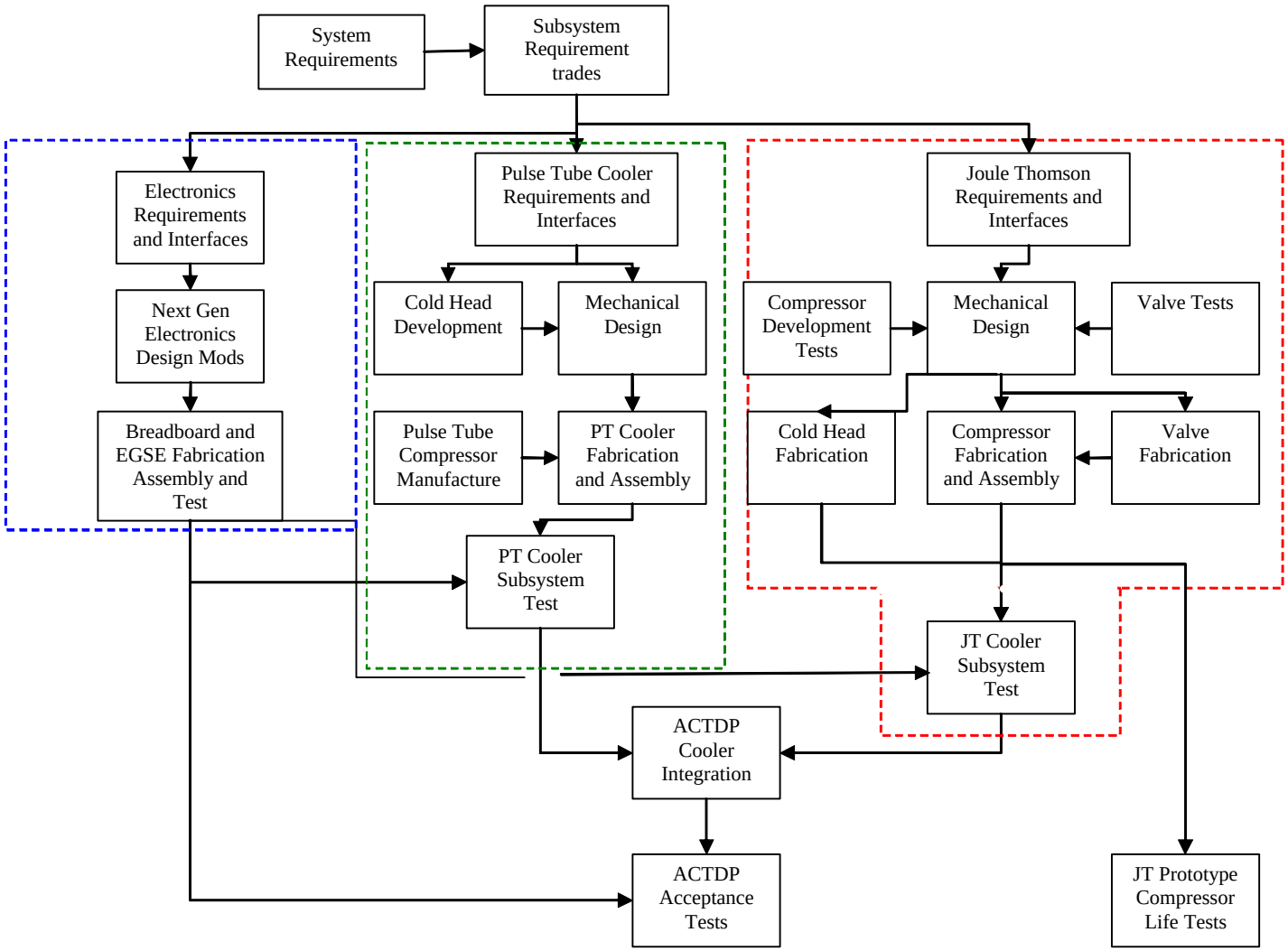
NORTHROP GRUMMAN
Space Technology

Program Milestones

Contract Deliverable Status			
1	Progress Report		Monthly
2	Kick-Off Meeting	NGST	5/21/03
3	Delta Preliminary Design Review	NGST	8/27/03
4	TIM #1/ Progress Briefing	JPL	10/16/03
5	TIM #2	NGST	1/20/04
6	Critical Design Review	JPL	5/18/04
7	TIM #3	NGST	7/20/04
8	TIM #4/ Progress Briefing	JPL	10/19/04
9	Environmental Test Review	NGST	12/21/04
10	TIM #5 (Pre-JWST NAR)	NGST	4/19/05
11	TIM #6	NGST	7/19/05
12	System Test Report (Draft)		7/19/05
13	Acceptance Data Package (Draft)		7/19/05
14	TIM #7/ Progress Briefing	JPL	10/18/05
15	Pre-Ship Review	NGST	12/20/05
16	System Test Report (Final)		12/20/05
17	Acceptance Data Package (Final)		12/20/05
18	Development Plan, Flight Cryocooler		12/20/05
19	Delivery: EM TMU, BE, spt & test eqpt.	JPL	12/20/05

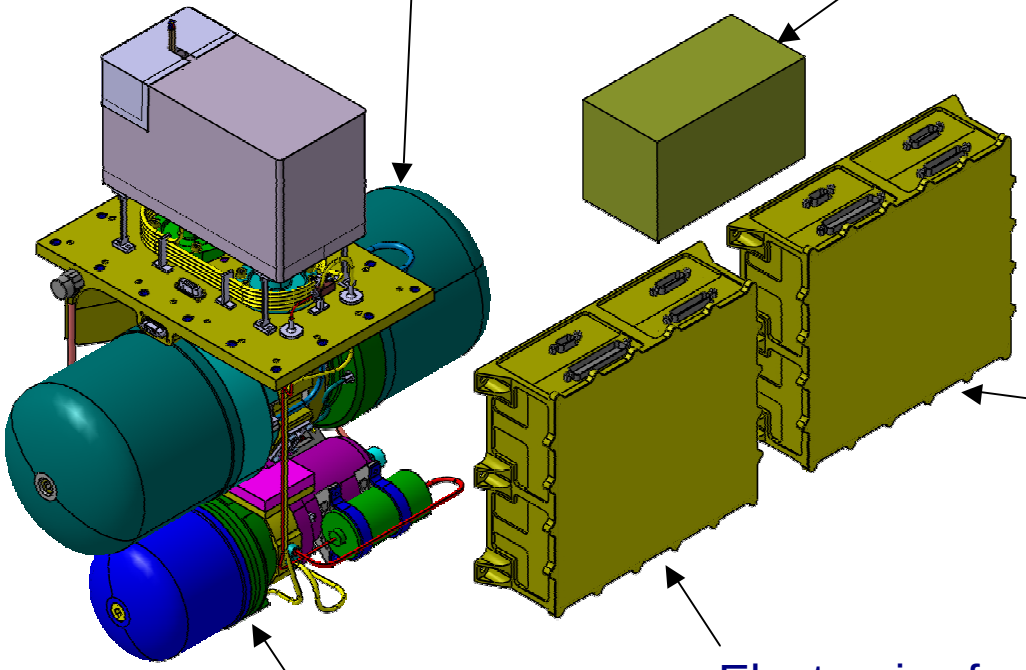
NORTHROP GRUMMAN
Space Technology

Project Flow

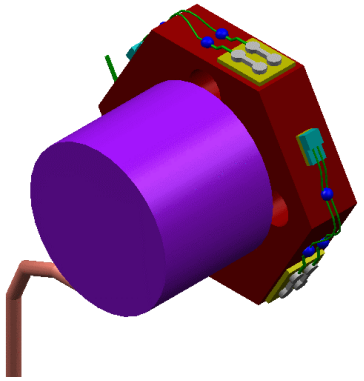


ACTDP Cooler Components

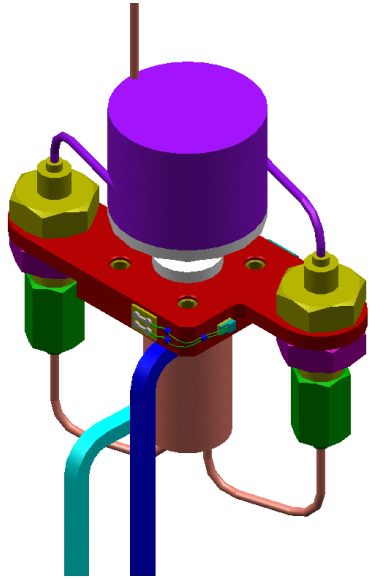
NORTHROP GRUMMAN
Space Technology



6K Cold block components



18K Cold block components



Bus-mounted Cryocooler components

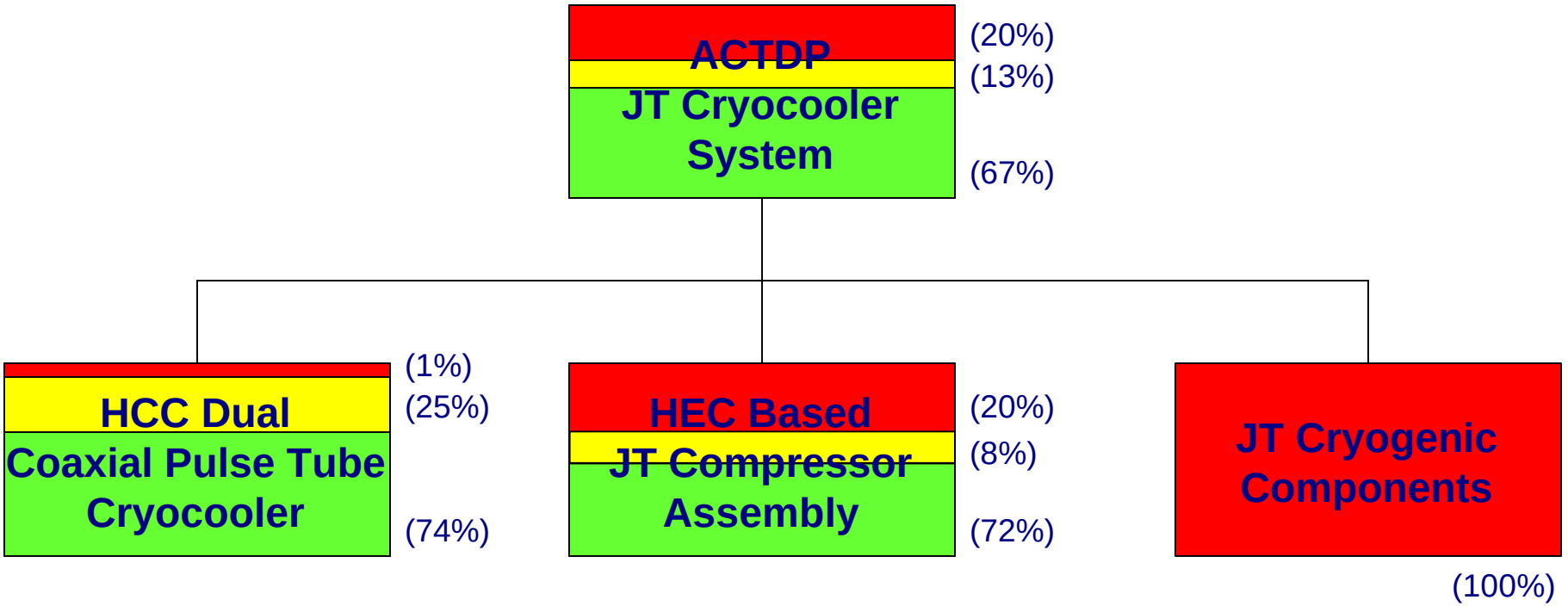
Instrument mounted components

Not to scale

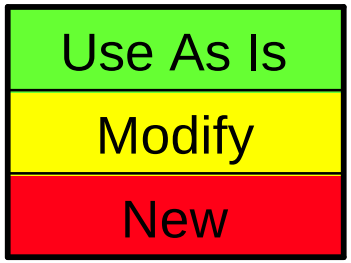
NORTHROP GRUMMAN
Space Technology

Mechanical Design Maturity - Summary

Top-Level Drawing Tree:



Color Key:



Program Status

- Project
  - Delta PDR completed 8/27/03
- System Engineering
  - Integrated system power model complete
  - Trades performed on:
    - Precooler temperature
    - JT mass flow
    - Complexity
    - Power on 85K precooler stage
    - Recuperator form
    - Packaging
- Pulse Tube pre-cooler
  - Extensive cold head modeling performed to direct lab development activities
  - 3rd stage cold head testing in process
  - Integrated two-stage 35K/17K cold head testing started

NORTHROP GRUMMAN
Space Technology

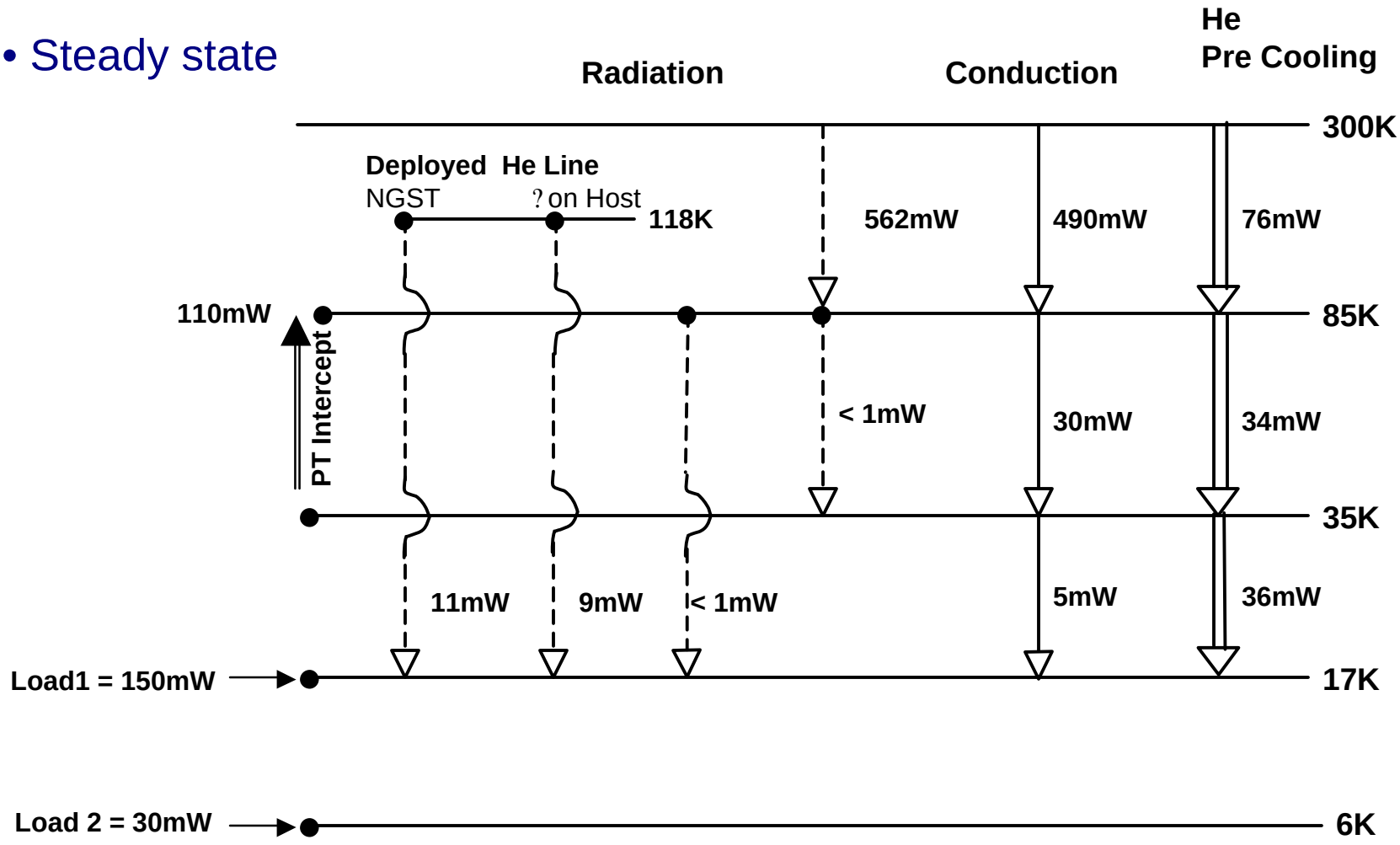
Program Status (cont)

- JT cooler
  - Refined preliminary baseline design for recuperator
  - Baseline preliminary precooler HEXs defined
  - Completed compressor testing
- Mechanical Design
  - Baseline preliminary design for majority of pulse tube pre-cooler cold heads, recuperator and HEXs defined
  - System mass budget with growth allocation established
- Electrical Design
  - Deferred to 2005
    - Electronics is essentially build to print therefore very low risk

NORTHROP GRUMMAN
Space Technology

Thermal map of ACTDP Cooler

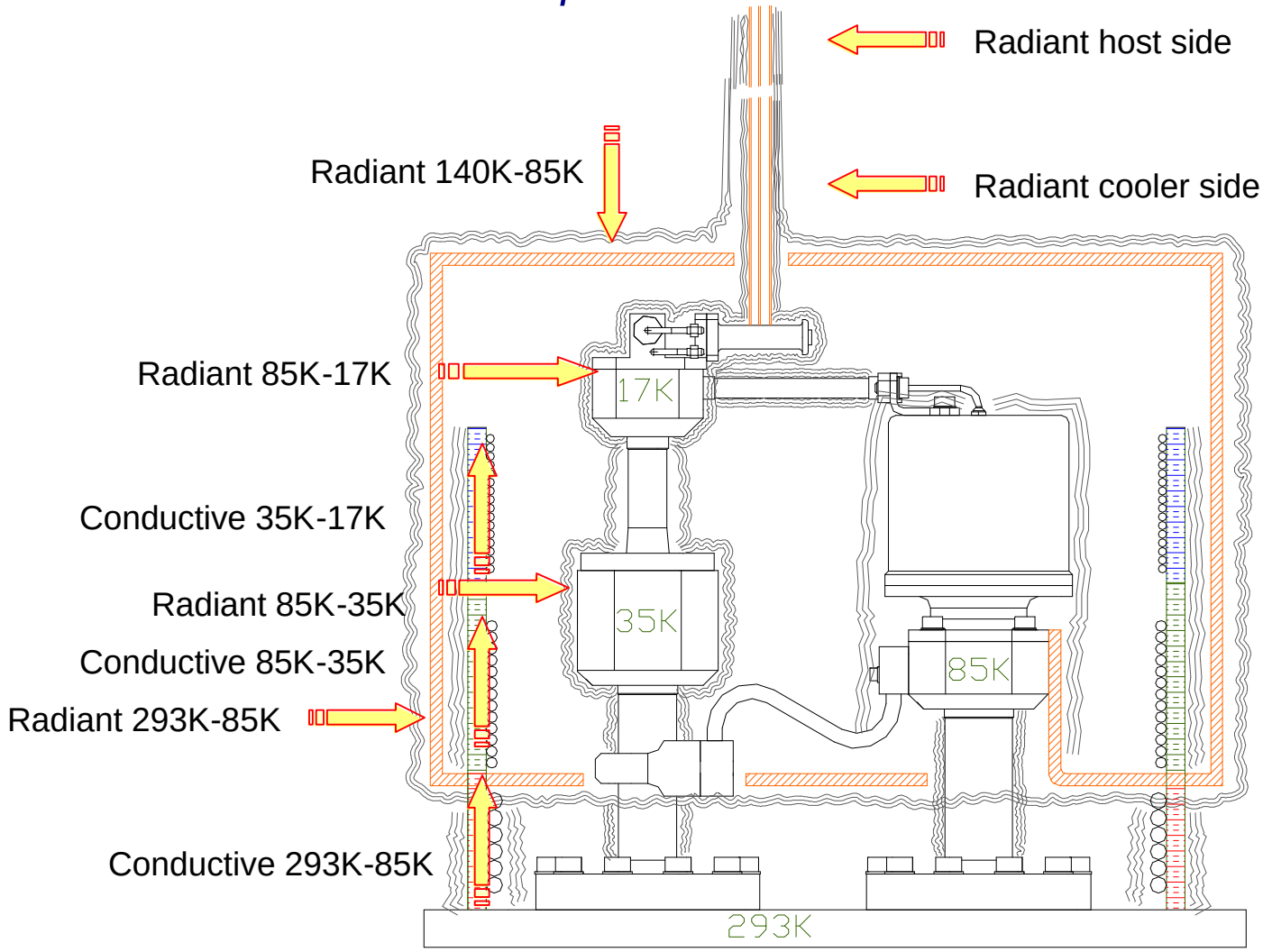
- Steady state



NORTHROP GRUMMAN
Space Technology

Parasitic Loads on PT Coldheads

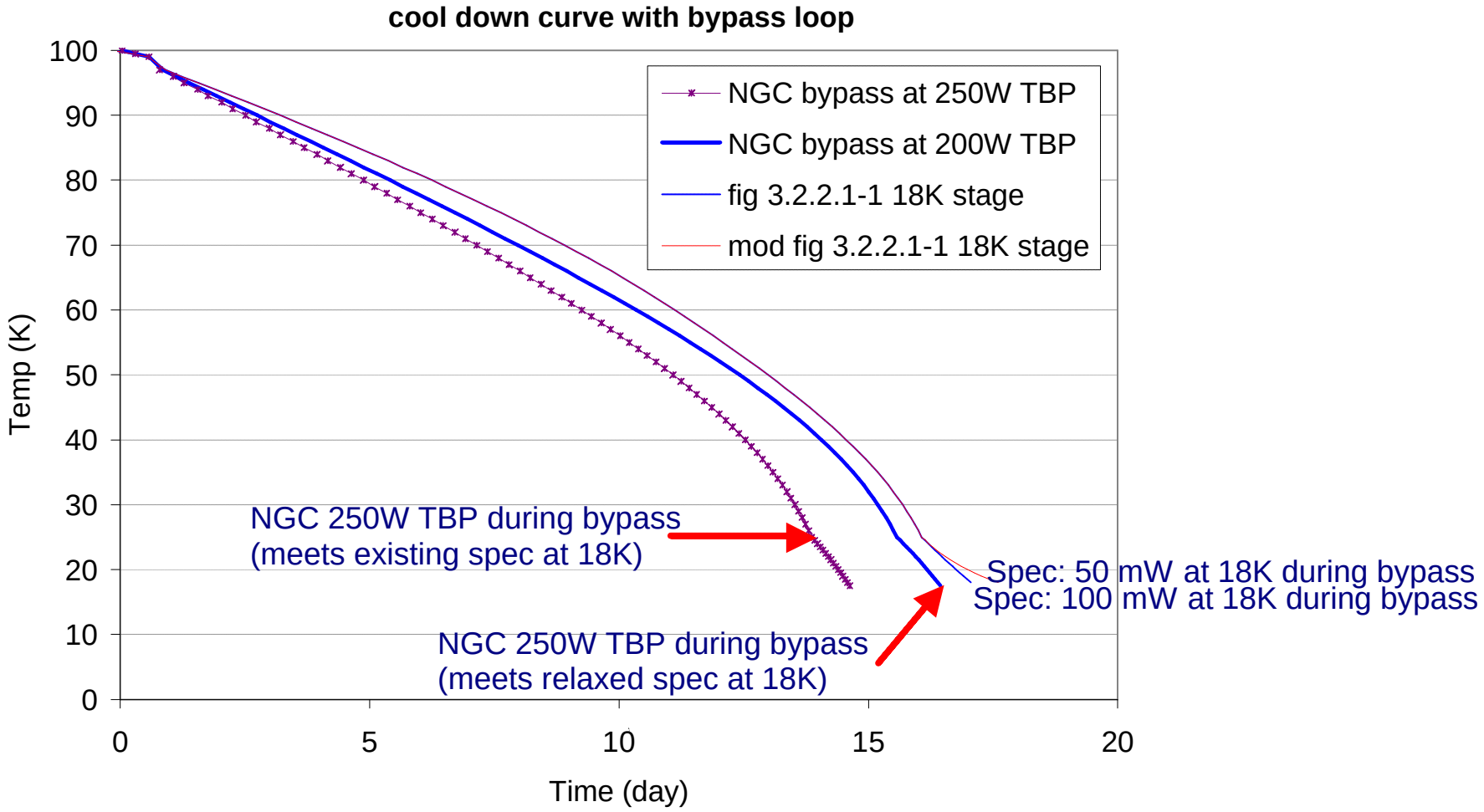
Thermal model accounts for all parasitic heat leaks



NORTHROP GRUMMAN
Space Technology

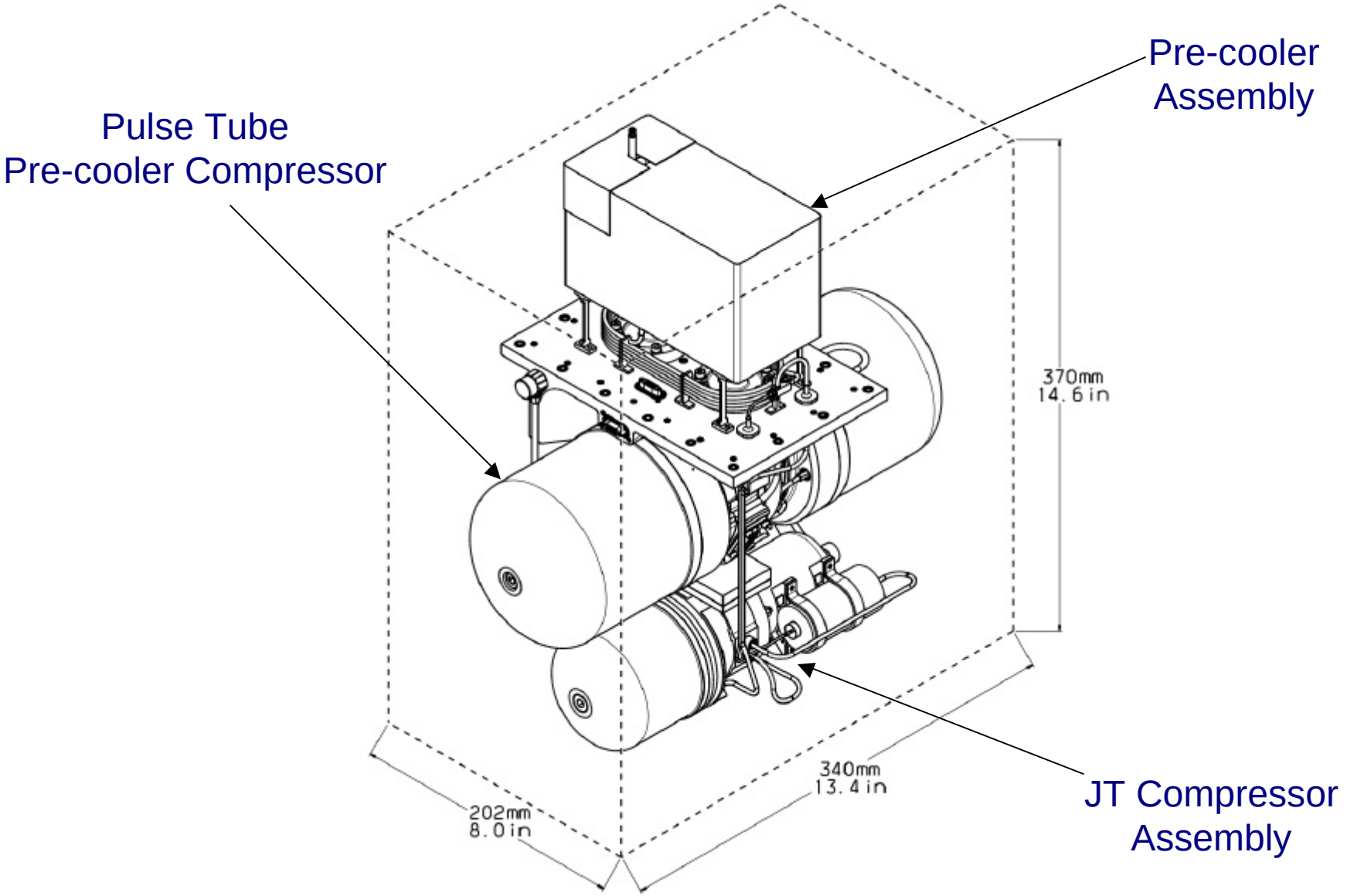
JT Loop – Cool down to 18K

Margin against the cooldown time corresponding to the spec



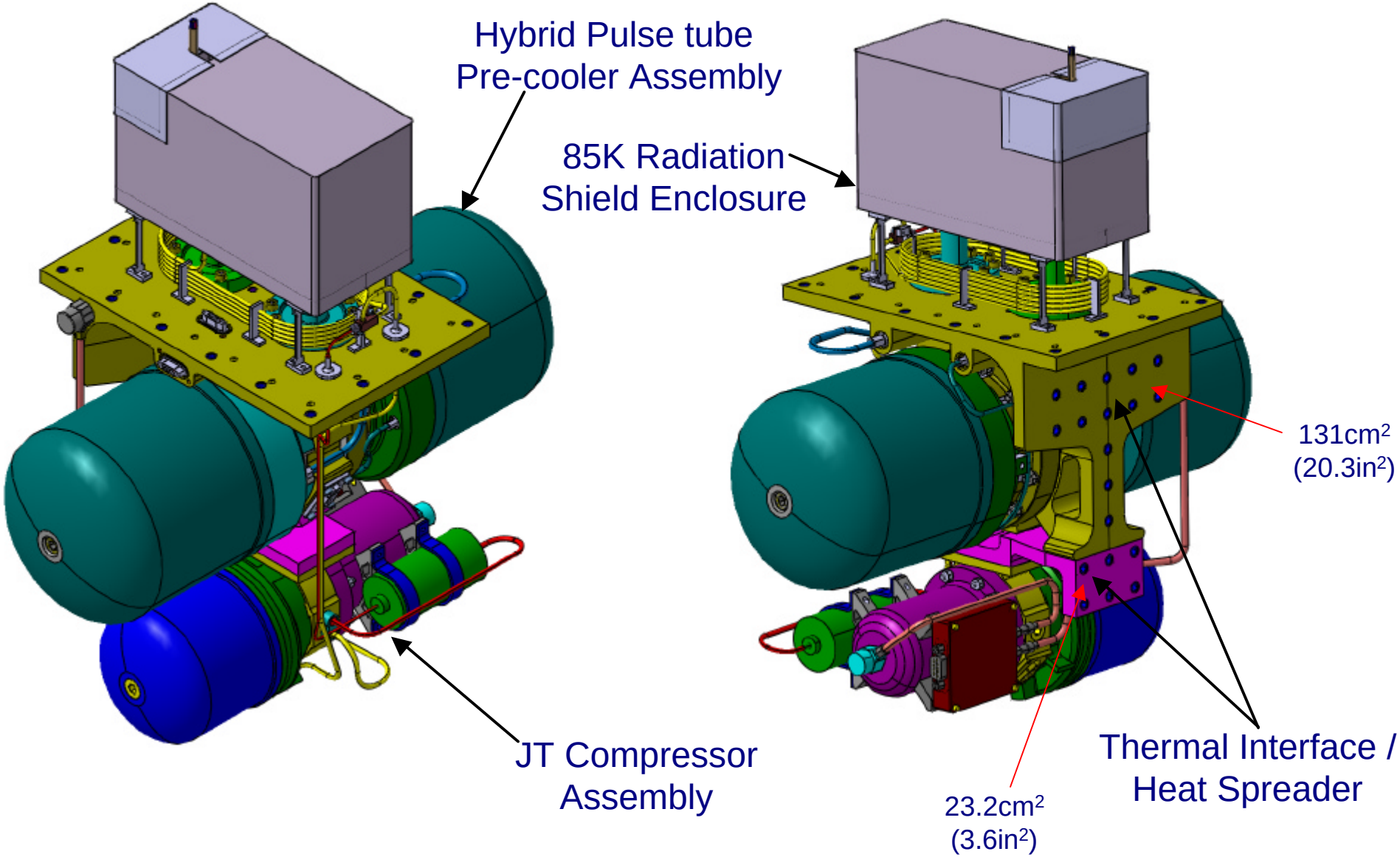
NORTHROP GRUMMAN
Space Technology

S/C Bus Mount Assembly – Envelope



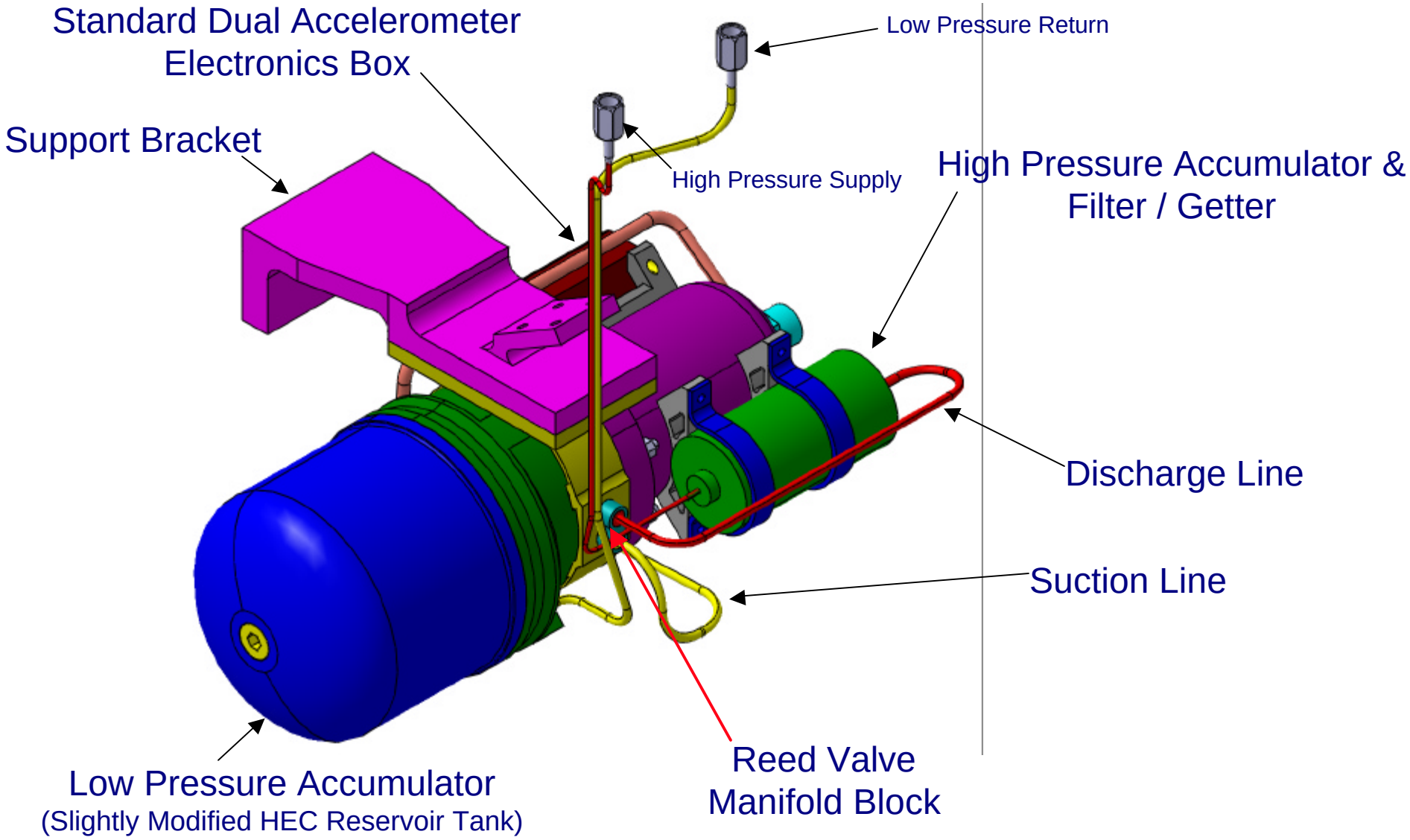
NORTHROP GRUMMAN
Space Technology

S/C Bus Mount Assembly Components



NORTHROP GRUMMAN
Space Technology

JT Compressor Components



Baseline Electronics Design Description

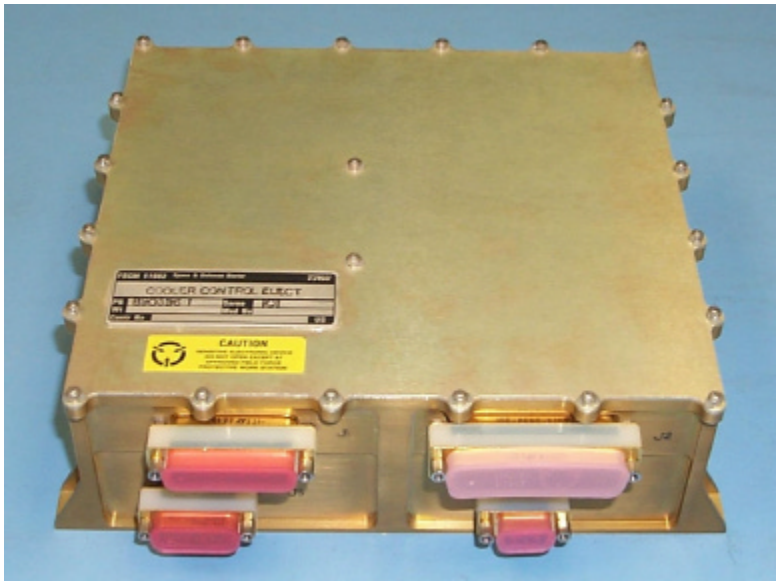
3 Electronics boxes:

- One HEC Electronics operates the J-T cooler
- One HEC Electronics operates the pre-cooler
- One Aux Thermometry Electronics provides 8 additional thermometry channels and a fine heater controller for the J-T coldhead

HEC Development Status (AFRL 95K Program):

- Cryocooler Electronics development complete
- EM unit acceptance tested and ready for delivery
- First flight units to be built on the Hybrid Test Program

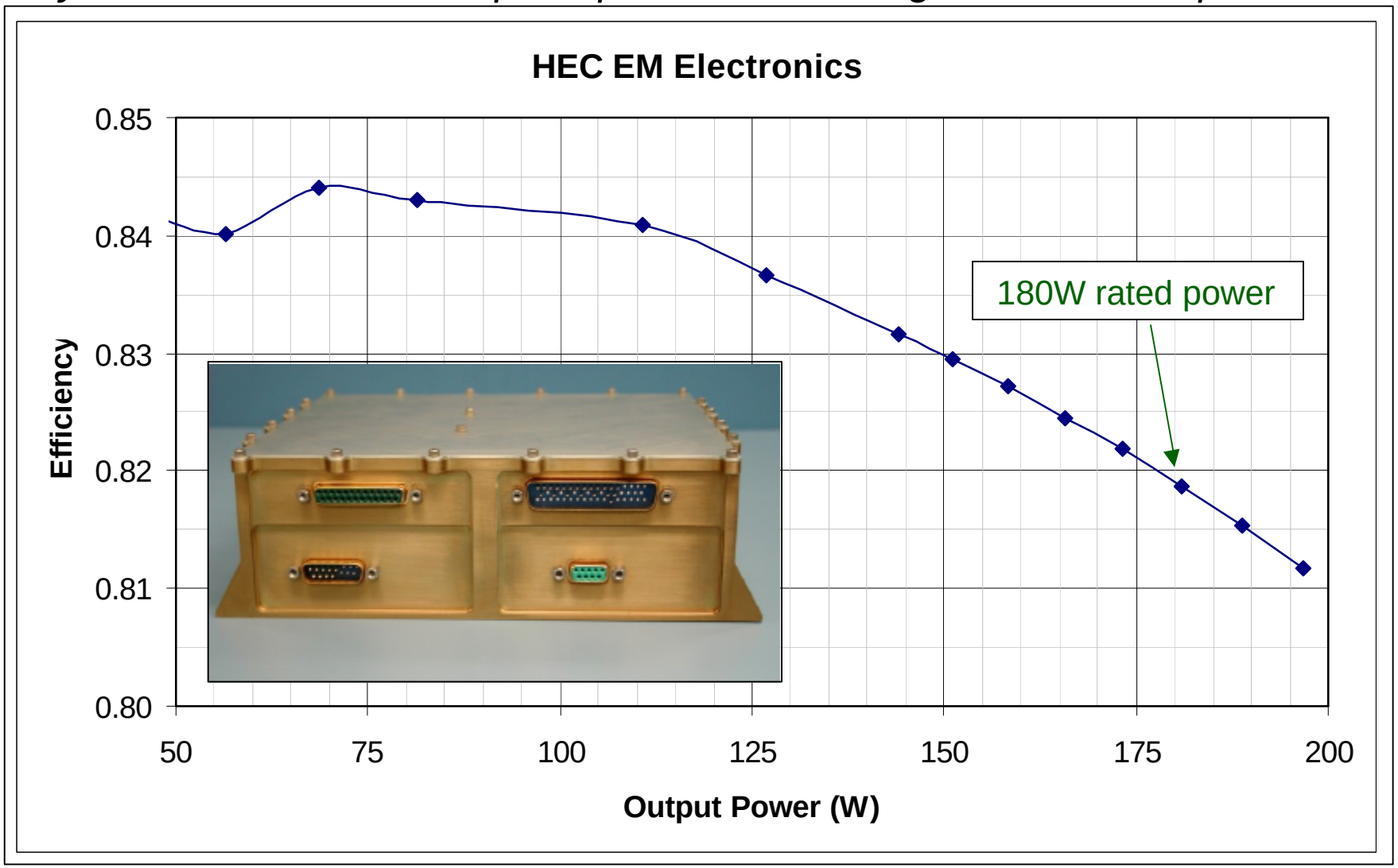
HEC Electronics



9.20?7.85?2.91
3.0Kg

HEC Electronics Efficiency

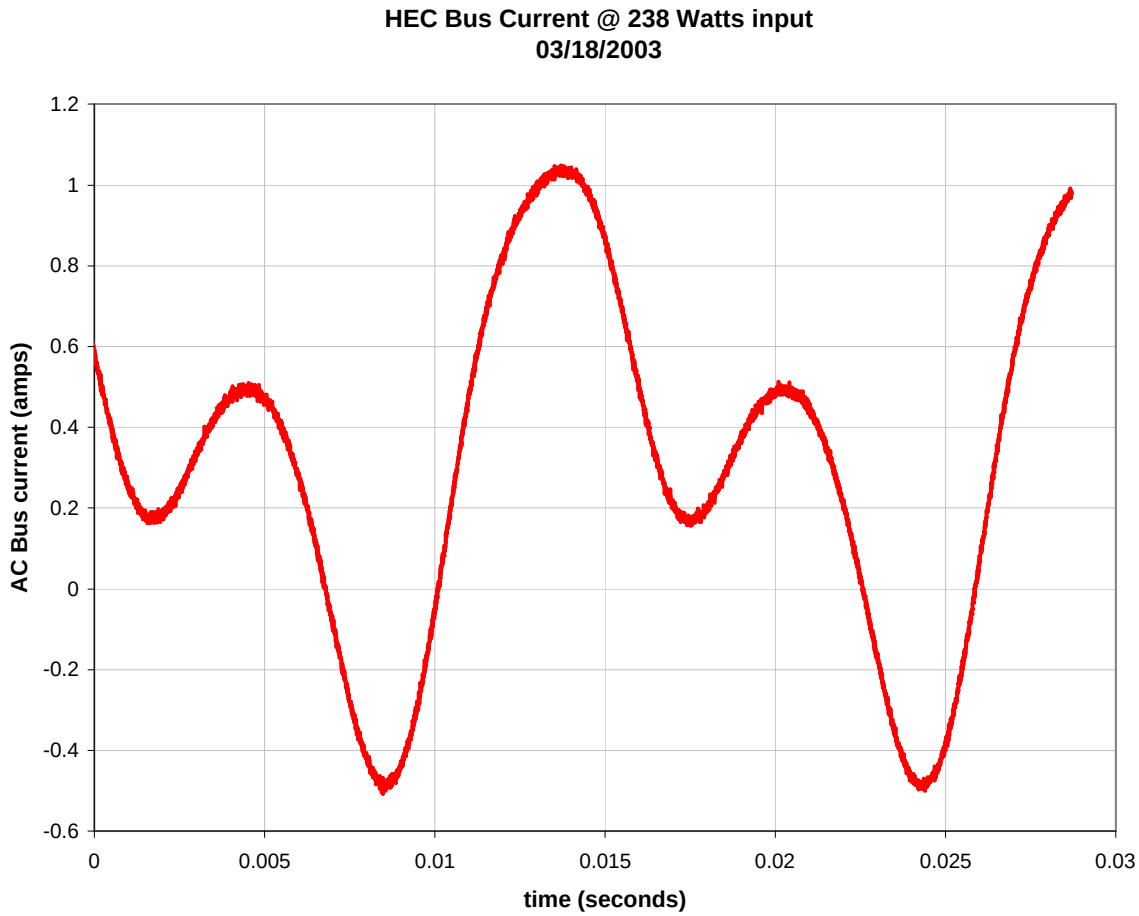
Very efficient over the complete performance range of delivered power



NORTHROP GRUMMAN
Space Technology

Active Ripple Control Provides >20dB Attenuation

Active ripple control relieves need for additional ~ 3Kg power bus filter



Improved power converter under development reduces ripple by another 12dB

Summary

- Program is progressing well
- Long lead hardware (build to print) in fabrication
- Key technical issues are being addressed